Journal of Pedagogical Research
Volume 10, Issue 1, 2026
https://doi.org/10.33902/JPR.202639742

Review Article

University–industry collaboration in post-Soviet states: A bibliometric study with implications for educational policy and practice

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University–industry collaboration has become an essential mechanism not only for fostering innovation and economic development but also for shaping the educational missions of universities. In post-Soviet states, however, University–Industry Collaboration has evolved within a distinctive context marked by the legacies of centrally planned economies, state dominance, and systemic transition, creating both structural barriers and new opportunities for higher education reform. This study conducts a bibliometric review of University–Industry Collaboration research in post-Soviet states between 1991 and 2024, complemented by a thematic analysis of selected studies. Using a dataset of 223 publications drawn from the Web of Science and applying co-citation analysis, bibliographic coupling, and thematic mapping, the study identifies the intellectual foundations, collaborative networks, and key thematic clusters shaping the field. The findings reveal five persistent challenges—state dominance, weak industry demand, underdeveloped commercialization infrastructure, human capital constraints, and cultural barriers—alongside emerging opportunities for curriculum reform, work-based learning, and employability-focused teaching models. Beyond mapping the research landscape, the study shows how University–Industry Collaboration intersects with higher education by reshaping curricula, influencing academic roles, and expanding student engagement with industry. These insights extend current debates by situating the post-Soviet experience within broader discussions of educational change, institutional reform, and the pedagogical implications of university–industry partnerships.

Keywords: Bibliometric analysis; Higher education; Post-Soviet states; Technology transfer; University–industry collaboration

Article History: Submitted 4 August 2025; Revised 5 November 2025; Published online 9 December 2025

1. Introduction

In recent decades, University–Industry Collaboration [UIC] has become a critical mechanism not only for fostering innovation and socio-economic development but also for shaping the educational missions of universities. By influencing curriculum design, academic staff development, and student learning opportunities, UIC reflects a global shift toward positioning universities as both producers of knowledge and active participants in educational and economic

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How to cite: Moldashev, K., Nurgabdeshov, A., & Kozhakhmet, S. (2026). University–industry collaboration in post-Soviet states: A bibliometric study with implications for educational policy and practice. *Journal of Pedagogical Research, 10*(1), 37-57. https://doi.org/10.33902/JPR.202639742

transformation (Etzkowitz, 2000; Leydesdorff & Etzkowitz, 1996). The post-Soviet states embarked on a profound systemic transition from command to market economy after the dissolution of the Soviet Union, necessitating a redefinition of relationships between academia, industry, and government. This context, shaped by the legacies of centrally planned economies, continues to present complex institutional, cultural, and structural challenges that affect the evolution of UIC in the region (Moldashev et al., 2019; Radosevic & Yoruk, 2014).

During the Soviet period, universities were subordinated to state ministries, with limited autonomy in shaping their educational and research agendas, and industry linkages were organized through central planning rather than collaboration (Kozlowski et al., 1999) The collapse of this system left universities with the dual task of reforming their educational missions while simultaneously building new types of external partnerships. While extensive research on UIC has examined Western contexts characterized by market-driven approaches, studies of post-Soviet countries emphasize a distinctive "Statist" Triple Helix model in which the government remains the dominant actor, constraining the autonomy of academia and industry (Ranga & Etzkowitz, 2013; Xue & Keat, 2025). This state-centric model shapes not only innovation outcomes but also the educational functions of universities, including how curricula are reformed, how students engage with industry partners, and how academic staff balance teaching, research, and third-mission activities (Acar, 2023; Bychkova, 2016; Jonbekova et al., 2025; Landoni & Muradzada, 2024). Despite this, the pedagogical and institutional implications of UIC in these contexts remain underexplored compared to its policy and commercialization dimensions.

This study addresses that gap by conducting a bibliometric review of UIC research in post-Soviet states published between 1991 and 2024. Bibliometric analysis provides a powerful means of systematically mapping scientific landscapes and uncovering the intellectual structures that underpin a research field (Aria & Cuccurullo, 2017). Using a dataset of 223 publications retrieved from the Web of Science, we applied bibliometric mapping techniques—including co-citation analysis and bibliographic coupling—to trace the evolution of UIC research, identify its thematic clusters, and highlight the intellectual foundations of the field. These approaches make it possible to reveal key research trajectories, influential publications, collaborative networks, and emerging directions in the literature (Börner et al., 2003; Van Eck & Waltman, 2010). To complement the bibliometric findings, a thematic analysis of 37 selected studies was undertaken, offering deeper insights into how UIC has been shaped by structural legacies, institutional reforms, and industry capacity. This additional layer of analysis also highlights the ways in which UIC intersects with higher education, particularly through curriculum reform, applied learning opportunities for students, and the evolving professional roles of academic staff.

Accordingly, this study maps the intellectual and thematic mapping of UIC in post-Soviet states and clarifies its educational relevance—specifically, how collaboration relates to curriculum reform, work-based learning, and graduate employability. On this basis, we state the study aims and research questions after establishing the educational significance. We therefore ask three research questions:

RQ 1) How has UIC research evolved in this region, and which authors, journals, and publications have had the most significant impact?

RQ 2) What core thematic areas drive the UIC discourse in post-Soviet states?

RQ 3) What future directions and opportunities exist for advancing UIC research in ways that inform educational policy and practice, including curriculum design, teaching approaches, and institutional reform?

This study contributes to the literature in three ways. First, it offers the first comprehensive bibliometric synthesis of UIC research in post-Soviet states, addressing an important gap. Second, it uncovers institutional and thematic trajectories showing how the region's unique socio-economic evolution has shaped UIC and its educational manifestations, including curriculum change and evolving academic roles. Third, it proposes a forward-looking research agenda to guide scholars, policymakers, and practitioners in strengthening university–industry partnerships that advance

both innovation and educational development in these transitional economies. Accordingly, this paper not only maps research trends but also situates UIC as a central element in the ongoing transformation of post-Soviet higher education systems, highlighting implications for learning, teaching, and academic capacity building. This highlights UIC not only as an innovation driver but also as a mechanism for rethinking teaching practices and preparing students for knowledge-intensive economies.

2. Literature Review

Research on UIC has established the roles of incentives, trust, and absorptive capacity in shaping knowledge transfer, alongside governance models such as the Triple/Quadruple Helix (e.g., Etzkowitz, 2000; Leydesdorff & Etzkowitz, 1996; Perkmann et al., 2013; Mascarenhas et al., 2018; Umirzakov et al., 2019a). Classic capability perspectives explain why firms with stronger internal R&D and openness capture greater value from academic ties (Cohen & Levinthal, 1990; Laursen & Salter, 2006). Bibliometric overviews also show UIC's interdisciplinarity and long-run growth (Bastos et al., 2021).

University–Industry Collaboration in Post-Soviet settings: in post-Soviet systems, path dependence and continued state dominance differentiate UIC trajectories. Evidence points to high public R&D shares, weak business demand, and fragmented commercialization interfaces (Dezhina & Etzkowitz, 2016; Dezhina, 2018; Landoni & Muradzada, 2024). The region frequently exhibits a "Statist" Triple Helix, policy instability, and "means–ends decoupling," with formal compliance sometimes outpacing substantive collaboration (Bychkova, 2016; Hladchenko & Pinheiro, 2018). Low absorptive capacity among firms and uneven sectoral participation further constrain joint R&D (Roud & Vlasova, 2018; Varblane et al., 2008).

Education-facing links: recent studies in the region underscore how UIC intersects with higher education through curriculum co-design, work-based learning, and employability, and how academic roles evolve with third-mission expectations (Jonbekova et al., 2020). This repositions UIC beyond technology transfer towards broader engagement that shapes teaching and student pathways. Despite growing work on policy and commercialization, there is no education-oriented bibliometric synthesis of UIC in post-Soviet states. By integrating bibliometric mapping with a thematic analysis of recent, region-specific studies, we show how UIC's systemic constraints (state dominance, low absorptive capacity, weak transfer infrastructure) coexist with actionable opportunities for higher education (curriculum modernization, industry-embedded pedagogy, and academic capacity building). This dual focus advances UIC scholarship and provides a practical knowledge base for policy and institutional reform in transitional systems.

2. Methodology

Bibliometric mapping techniques, grounded in quantitative methods, effectively illustrate and visualize knowledge domains, leveraging datasets from comprehensive databases such as Clarivate Analytics' Web of Science Core [WoS] (Börner et al., 2003). These approaches are vital in identifying research trends and patterns using advanced visualization tools like VOSviewer and Bibliometrix software. Developed by Van Eck and Waltman (2010), the VOSviewer software is particularly useful for its complex capabilities in producing bibliometric maps that depict the relationships between publications, authors, and institutions. This software also facilitates deep data exploration with interactive features such as zooming and panning, essential for detailed scholarly analysis (Behl et al., 2022). Similarly, the Bibliometrix R-tool is a robust tool for comprehensive science mapping analysis across various disciplines. Its integration capabilities with automated workflows enhance its utility, making it an essential asset for academic research and bibliometric analysis (Aria & Cuccurullo, 2017).

In our work, the mapping technique was applied using a similarity matrix derived from a normalized co-occurrence matrix, adjusting for variations in item occurrences. VOSviewer utilizes an association strength measure, also known as a proximity or probabilistic affinity index, to

estimate the similarity between items based on their co-occurrences, relative to their expected occurrences if independent (Van Eck & Waltman, 2010).

$$S_{ij} = \frac{C_{ij}}{w_i w_j}$$

This methodological approach is particularly well suited for educational research because it enables a systematic examination of how UIC-related scholarship intersects with teaching, curriculum development, and broader higher education transformation. By mapping research trajectories over time, bibliometric analysis helps to reveal how universities' educational missions are discussed and operationalized within collaboration literature, offering insights relevant to both policy and pedagogy.

2.1. Research Design

We used a two-stage design: (i) bibliometric mapping of Web of Science records to trace the intellectual and thematic structure of UIC in post-Soviet states; and (ii) a complementary thematic analysis of a purposive subset of recent papers to interpret education-facing implications (curriculum, work-based learning, academic roles).

2.2. Data Collection and Screening

We combined bibliometric mapping of WoS records with a complementary thematic analysis to produce actionable insights for education policy and practice. Specifically, we extracted data from articles published from 1991 to 2024. The search terms were strategically chosen to encompass a broad spectrum of concepts related to UIC, including "university industry" OR "university–industry" OR "university/industry" OR "academic–industry collaboration" OR "university–enterprise cooperation" OR "university–business collaboration" OR "industry–academia partnerships" OR "R&D collaboration" OR "collaborative research" OR "university spin-offs" OR "research commercialization" OR "technology transfer" OR "knowledge transfer" OR "triple helix" OR "quadruple helix" OR "innovation ecosystems" OR "open innovation" OR "science and technology parks" OR "research consortia" OR "knowledge transfer partnerships" OR "entrepreneurial universities" OR "academic entrepreneurship" OR "regional innovation systems" OR "technology incubators" OR "academic knowledge exchange" OR "university-industry engagement")) AND TS=("Post-Soviet states " OR "Former Soviet Union" OR "Eurasian Economic Union" OR "Commonwealth of Independent States" OR "Russia" OR "Ukraine" OR "Belarus" OR "Kazakhstan" OR "Armenia" OR "Azerbaijan" OR "Georgia" OR "Moldova" OR "Uzbekistan" OR "Turkmenistan" OR "Kyrgyzstan" OR "Tajikistan" OR "Central Asia". The initial query in the Web of Science database yielded over 620 records, after a meticulous screening process, which involved removing duplicates, non-English papers, and those outside the scope of UIC, the final dataset comprised 223 relevant publications. These publications span a period critical for observing the post-Soviet transition and its impact on academic and industrial collaborations.

To map the landscape of UIC research in post-Soviet states, we applied co-citation and bibliographic coupling analyses using VOSviewer software. Co-citation, where two works are cited together, indicates thematic or methodological links (Small, 1973), helping identify key foundational and influential works. Conversely, bibliographic coupling (Van Eck & Waltman, 2017) analyzes references within documents to explore similarities between studies, shedding light on current trends and emerging themes in UIC research. Additionally, Bibliometrix software enhanced our analysis with trend analysis and thematic mapping, providing deeper insights into the intellectual structure and evolution of the field.

2.3. Bibliometric Mapping Procedures

Complementing the bibliometric analysis, a thematic analysis was conducted to explore in greater depth the scholarly perspectives on national innovation systems, university-industry collaboration, and the state-university-industry nexus in the context of post-Soviet countries. This research phase

focused on a purposive sample of 37 articles selected for their relevance to the topic out of a pool used for bibliometric analysis.

The inclusion criteria for the thematic analysis centered on identifying articles that provided in-depth empirical or conceptual engagement with innovation systems at the national level, particularly those examining the roles of state institutions, universities, and industries in fostering collaboration (Nguyen et al., 2025; Sarzhanova & Nurgabdeshov, 2025). Articles were selected if they addressed the structural, institutional, or functional dynamics of university-industry linkages or analyzed the formation and evolution of innovation systems within individual post-Soviet states.

Conversely, articles were excluded if their treatment of post-Soviet countries was only incidental—such as being part of a larger comparative study with minimal focus on the region—or if their primary emphasis lay on multinational enterprises, foreign direct investment, or global technology transfer mechanisms, with little attention paid to domestic university-industry relationships. Similarly, articles that merely referenced university-industry collaboration without engaging substantively with its drivers, constraints, or configurations within the post-Soviet context were also excluded.

The selected articles were reviewed in full, and key information was extracted regarding their research objectives, methodological approaches, country focus, and principal conclusions. This information was used to identify patterns and recurring themes across the literature. The analysis employed an inductive coding strategy, allowing themes to emerge from the articles' content rather than being imposed a priori.

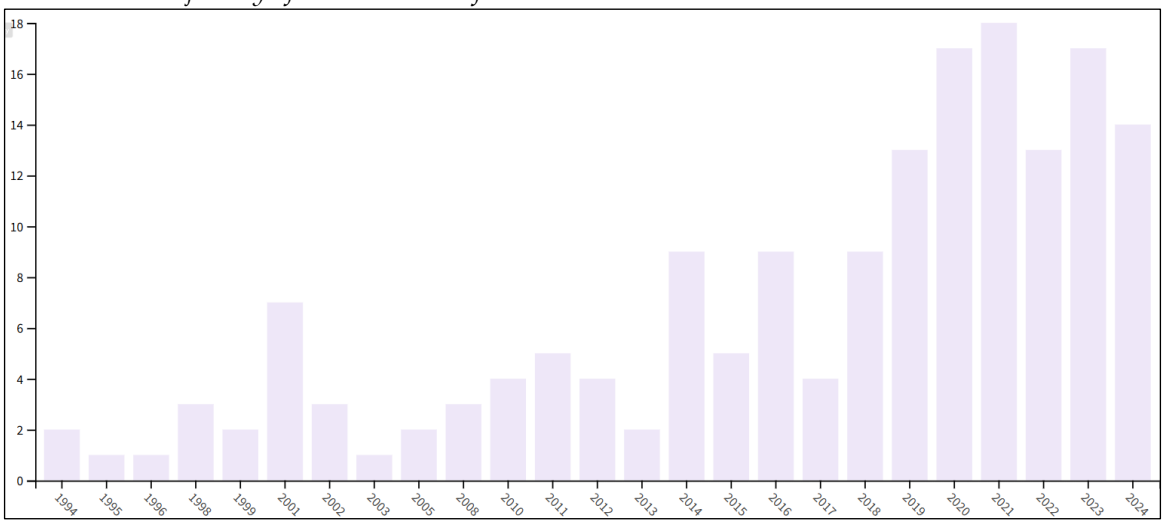
3. Results of Bibliometric Analysis

This section reports the bibliometric results in five steps. First, we describe annual publication dynamics. Second, we profile leading journals and countries and present the journal co-citation structure. Third, we examine influential authors and references. Fourth, we map topical trends using keyword frequency and overlay visualizations. Finally, we provide historiographic and thematic-map evidence to position motor, basic, and niche themes that structure UIC scholarship in post-Soviet contexts.

3.1. Annual Publication

Figure 1 presents annual UIC-related publications (1991–2024), showing growth phases.

Figure 1
Publication Trajectory of UIC Research from 1991 to 2024



The publication timeframe of the academic papers ranged from 1991 to 2024. The data can be divided into two main intervals. The first interval, from 1993 to 2003, shows a low level of

publication activity with only a minor uptick towards the end of this period. The second interval, from 2013 to 2023, displays a significant increase in publication volume, indicating a growing interest in UIC research. This upward trend suggests that the field is expanding and evolving, opening up possibilities for new research areas and understudied topics, and applying novel methodologies in future studies (see Figure 1).

3.2. Leading Journals

Table 1 reports the ten most active journals in our dataset

Table 1
Top Ten Journals Publishing on UIC

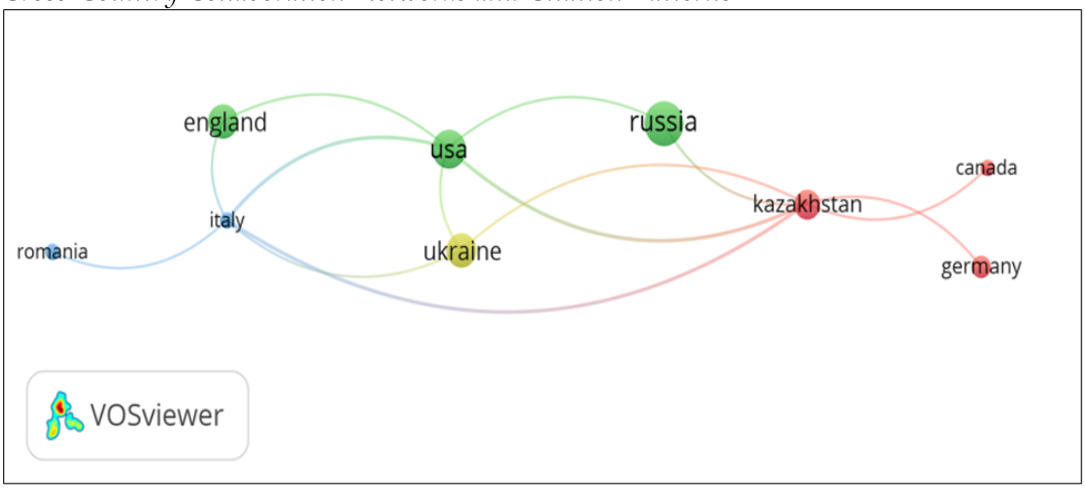
Rank	*Journal title*	*Country*	*Total number of publications*
1	Science and Public Policy	United Kingdom	12
2	Journal of Technology Transfer	United States	10
3	Research Policy	Netherlands	8
4	Technovation	United Kingdom	7
5	Industry & Higher Education	United Kingdom	6
6	Minerva	United Kingdom	5
7	Journal of Business Venturing	United States	5
8	International Journal of Technology Management	Switzerland	4
9	Higher Education	Netherlands	4
10	Technology Forecasting & Social Change	United States	4

The bibliometric analysis of publications on UIC in the post-Soviet context has revealed distribution across many journals. From the dataset, 223 scholarly articles were published across 151 unique journals. Ten most prolific journals that have contributed extensively to this research domain. The ranking of these journals is based on their total publication count, with journals like Science and Public Policy and Journal of Technology Transfer leading due to their focus on technology, policy, and innovation, which are key aspects of university-industry collaboration (see Table 1).

3.3. Most Productive Countries

Figure 2 visualizes cross-country collaboration networks and citations.

Figure 2
Cross-Country Collaboration Networks and Citation Patterns



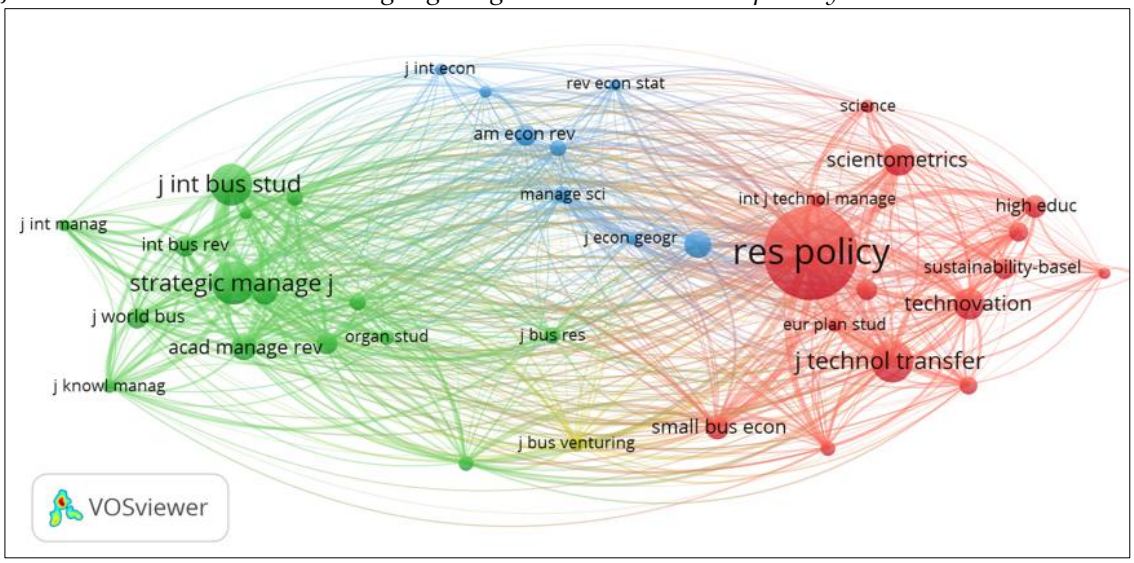
A country's intellectual output can be assessed by examining the overall number of articles it produces and the total number of citations it receives in a particular field of study.

The network visualization of UIC across various nations. The USA, with strong ties to Ukraine and UK, is a major node reflecting robust transatlantic relationships. Another cluster, dominated by Russia, exhibits strong links to Germany and Kazakhstan, highlighting a focus on regional cooperation both within and beyond post-Soviet states. A smaller cluster includes Canada and Kazakhstan, indicating specific strategic partnerships, as shown in Figure 2.

3.4. Analysis of Journal Co-citations

Figure 3 depicts journal co-citation clusters, indicating the field's interdisciplinary anchors.

Figure 3
Journal Co-Citation Clusters Highlighting the Field's Interdisciplinary Foundations



Based on mutual citations, the co-citation analysis depicted in the graphic reveals interrelated links between academic publications. This complex network forms several clusters, each representing a distinct study area. Within the green cluster, journals such as the 'Journal of International Business Studies' and 'Strategic Management Journal' focus on business and management studies. The red cluster, featuring terms like 'Research Policy' and 'Technovation,' highlights a significant emphasis on innovation, technology transfer, and policy research. Publications in the blue cluster, including the 'Journal of Economic Geography,' primarily focus on geographical and economic analysis. This map demonstrates the intersections of various fields and reflects the interdisciplinary discourse that characterizes the UIC field.

3.5. Most Productive Authors

Table 2 presents the leading authors in the field based on publication output.

Table 2
Productive Authors

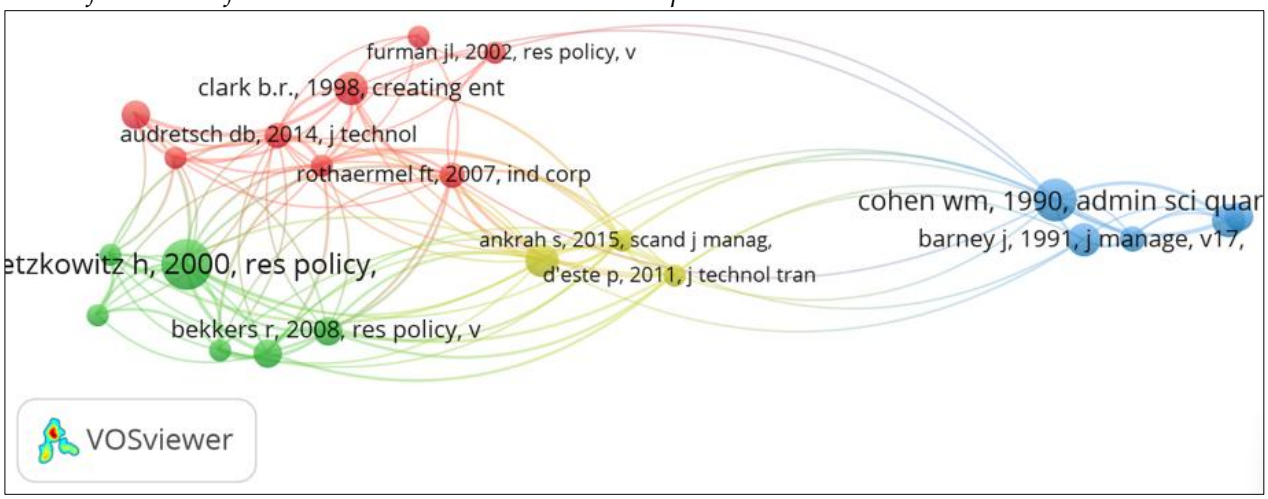
Authors	*No. of articles*	*No. of citations*	*h-index*
Khachatryan, K.	12	357	14
Albats, E.	9	274	13
Jonbekova, D.	7	190	12
Smirnova, Y.V.	6	155	11
Cunningham, J.A.	6	148	10
Belitski, M.	5	112	9
Marozau, R.	4	90	8
Hakobjanyan, A.	3	88	7
Keryan, T.	2	75	6
Nikoghosyan, K.	2	60	5

In our study, we identified the ten most prolific authors within our research area and ranked them based on their h-index. This index reflects not only their productivity but also the impact of their work through citations. This metric provides insights into their significant contributions to the field and hints at collaborative efforts within their research output (see Table 2).

3.6. Reference Analysis

Figure 4 summarizes the most frequently cited references that shape the field's intellectual foundations.

Figure 4
Core Influential References in the UIC Research Landscape

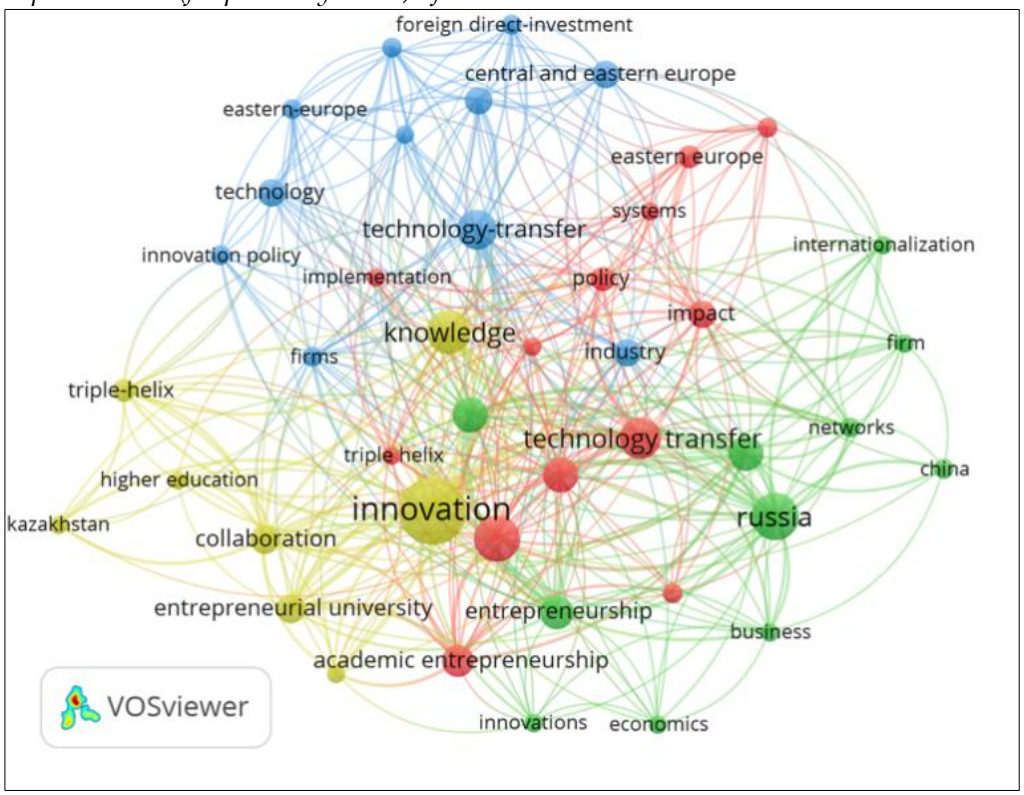

furman jl, 2002, res policy, v
clark b.r., 1998, creating ent
audretsch db, 2014, j technol
rothaermel ft, 2007, ind corp
cohen wm, 1990, admin sci quar
barney j, 1991, j manage, v17,
ankrah s, 2015, scand j manag,
d'este p, 2011, j technol tran
etzkowitz h, 2000, res policy,
bekkers r, 2008, res policy, v
VOSviewer

Reference analysis is a widely used method to establish and visualize the intellectual map of a research topic. In this study, we analyzed a comprehensive dataset of 7,341 references, utilizing VOSviewer to highlight key works. Figure 4 showcases the most frequently cited references from our dataset, emphasizing the influential documents in the field. The visualization highlights critical contributions, such as Cohen and Levinthal's 1990 paper on absorptive capacity, which remains fundamental in understanding how companies integrate and utilize new knowledge. Additionally, Etzkowitz's (2000) study on the dynamics of the interplay among universities, industry, and government demonstrates the significant impact of the Triple Helix model on research policies. Another key study examining the impact of entrepreneurship on innovation and economic growth underscores the crucial role of collaboration between academia and industry in fostering sustainable development (Audretsch, 2014). These works highlight the diverse yet interconnected fields of innovation research, economic policy, and strategic management, illustrating the complex network of knowledge that supports contemporary research on university-industry collaborations.

3.7. Topical Trends

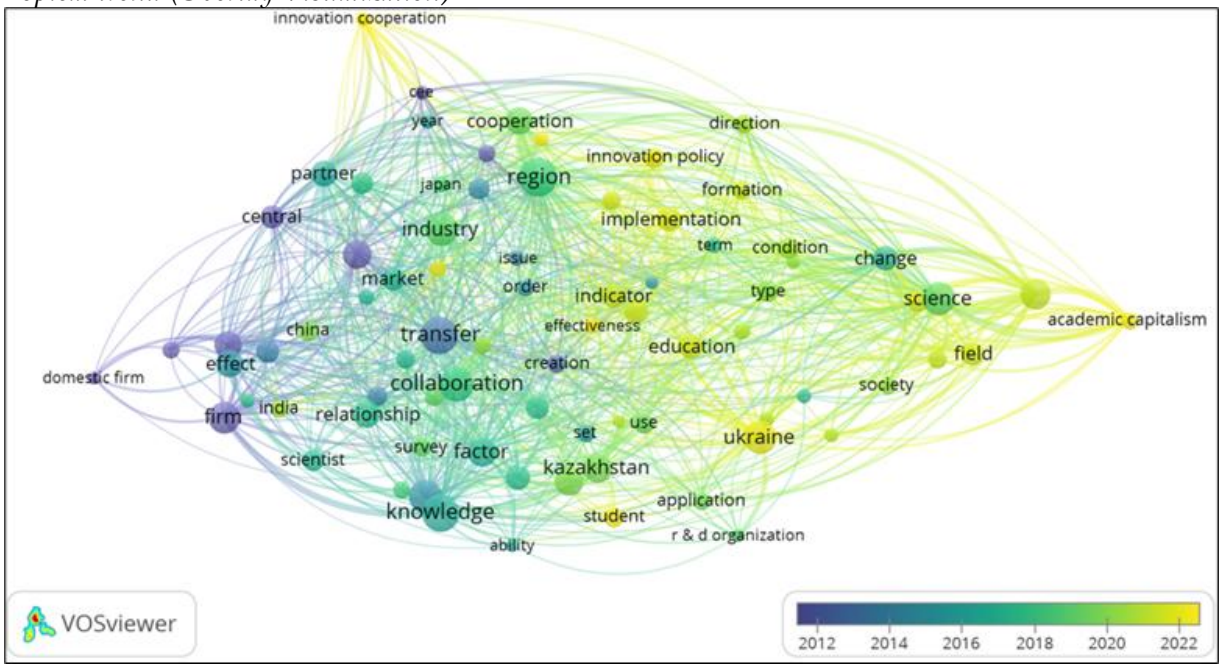
From the dataset, a total of 875 terms were extracted. Figure 5 displays the 43 keywords that appeared at least five times. The size of the circles in the figure indicates the importance of each term. At the same time, the proximity of the words and the strength of the connections between them illustrate their interrelationships. These terms are categorized into three primary research areas: technology and policy (red), practical industrial applications (yellow), international aspects (blue), and educational partnerships (green). This mapping not only categorizes the existing research landscape but also serves as a crucial resource for identifying emerging trends and focal areas within the field, informing future research into the dynamics of UIC in post-Soviet nations.

Figure 1
Topical trends (frequent keywords) of UIC research



According to the overlay visualization in Figure 6, research from 2012 to 2022 shows a significant shift in focus regarding international technology transfer and collaboration. Initial investigations were primarily concerned with the mechanics of technology transfer involving countries like China, India, and Japan, as well as Central Asian nations, with an emphasis on the impacts on

Figure 6
Topical trend (Overlay Visualization)

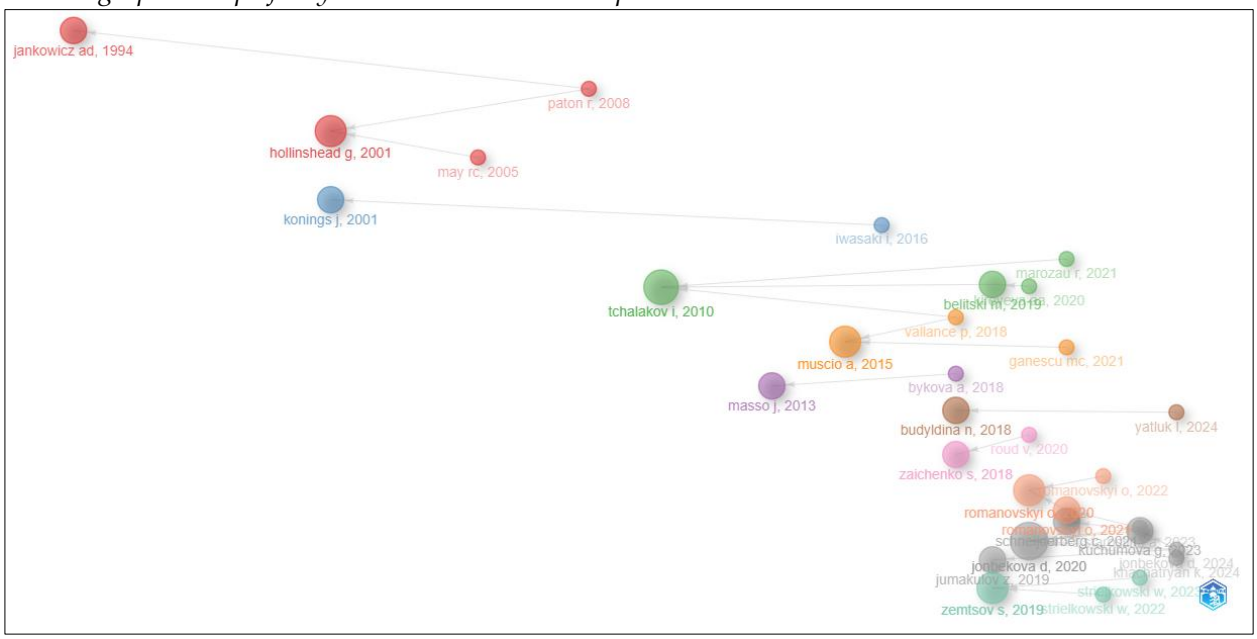


domestic firms. More recently, the research has shifted towards 'academic capitalism,' analyzing how market-driven influences within academia affect regional innovation systems through changes in policy and efficiency. Earlier studies, from 2012 to 2016, emphasized the role of higher education in fostering scientific collaboration and enhancing the capabilities of local industries, setting the stage for current discussions on broader socio-economic impacts and policy frameworks.

3.8. Historiograph

Figure 7 visualizes the chronological development of key works and the citation connections among them.

Figure 7
Historiographic Map of Key Contributions and Temporal Citation Paths



The historiograph shown in Figure 7 visually depicts scholarly developments and significant contributions in university-industry collaborations across various nations from 1994 to 2024. This map covers a broad spectrum of research studies addressing various aspects of innovation, policy evolution, and the strategic roles of academia and industry in fostering economic development and technological progress.

The analysis begins with Jankowicz's influential 1994 work, which laid the foundation for understanding the dynamics of knowledge transfer between universities and industries. It progresses through other studies, such as Hollinshead's 2001 investigation into strategic partnerships and May's 2005 exploration of policy frameworks that facilitate such collaborations. These foundational studies highlighted key strategies for aligning educational programs with industry needs, emphasizing the importance of adaptability and skill enhancement in post-Soviet contexts.

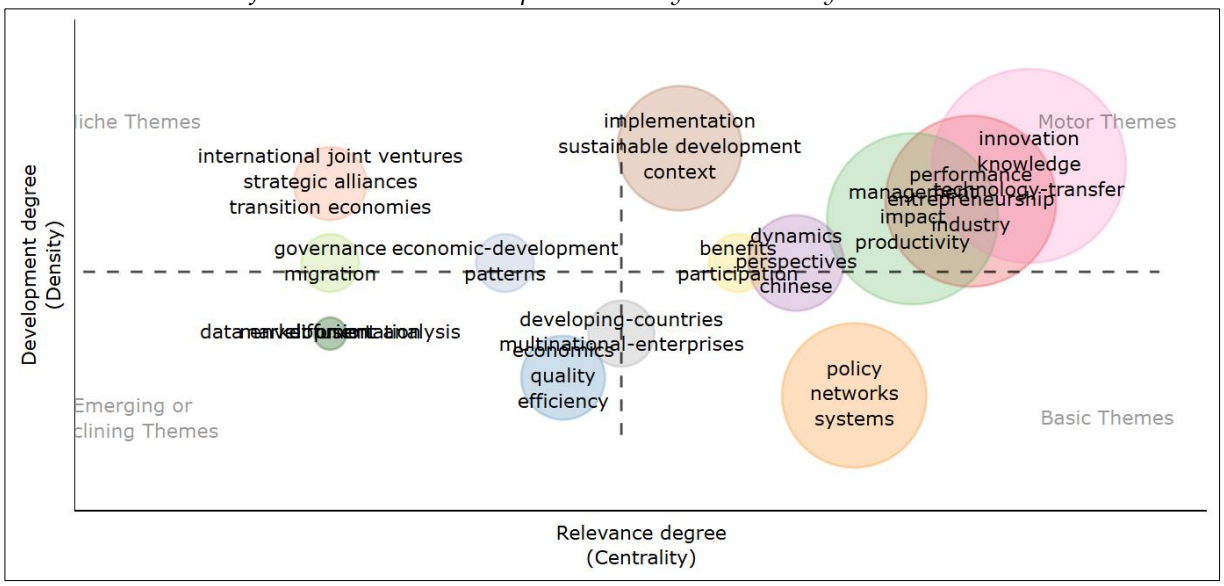
As the timeline progresses to more recent years, the focus shifts to more specialized topics. For instance, Iwasaki's 2016 study examines how cultural differences impact collaboration efficiency, and Tchalakov's 2010 research investigates innovation systems. Marozau's latest contributions in 2021 delve into the implications of global economic shifts and digital transformation on collaborative efforts.

3.9. Thematic Map

The thematic map shown in Figure 8 provides a detailed examination of the UIC landscape by identifying the primary research themes in this field. This map categorizes themes into four

quadrants based on two axes: centrality (degree of relevance) and density (degree of development), representing the research themes' strategic significance and cohesiveness, respectively.

Figure 8
Thematic Structure of the Field Based on Topic Centrality and Density



Motor Themes, positioned in the upper right quadrant with high centrality and high density, encompass essential themes such as 'innovation,' 'knowledge,' 'technology transfer,' 'performance,' 'management,' and 'entrepreneurship.' These themes are pivotal in discussions about UIC, highlighting their role as catalysts for research activity and industry standard setters. They demonstrate a robust fusion of theoretical concepts and practical implications, strengthening the link between academic research and industrial application. This cluster underscores the critical role of knowledge transfer in enhancing organizational performance and driving technological innovation across industries.

Fundamental Themes in the lower right quadrant exhibit high centrality but lower density and include 'policy,' 'networks,' and 'systems.' These themes provide the fundamental framework that underpins and guides the dynamics of UIC. Although these areas are less developed, they are essential for understanding the regulatory and systemic aspects that influence collaborations between academia and industry. The positioning of these themes indicates a pressing need for further research and development to enhance the effectiveness and efficiency of policies and system frameworks that support UIC.

Niche Themes in the upper left quadrant show high density but lower centrality and include specialized subjects such as 'international joint ventures,' 'strategic alliances,' 'transition economies,' and 'governance.' These themes are well-developed within their specific research areas but have limited influence on the broader UIC context. This suggests that while they are significant in specific scenarios, their relevance and impact on the general field are restricted.

Overall, the thematic map illustrated in Figure 8 serves as a strategic resource for identifying and examining UIC research's central and peripheral aspects. It enhances understanding of how various themes interrelate and influence each other and provides a roadmap for future research directions by highlighting areas ripe for further exploration and development.

4. Thematic Analysis

Based on co-citation analysis to identify prominent papers and focusing on recent research exploring UIC in post-Soviet countries, we selected 37 articles out of 223 for thematic analysis. We identified five major themes in the research on UIC in the region: (1) the dominant role of the state

and the persistence of Soviet-era path dependence; (2) weak industry demand and low absorptive capacity; (3) underdeveloped institutional frameworks and commercialization infrastructure; (4) human capital and cultural barriers within academia; and (5) emerging opportunities and recommendations for improvement.

4.1. The Dominant Role of the State and Path Dependence

A pervasive theme across the literature on UIC in Post-Soviet states is the enduring influence of the state and the deep-seated legacy of Soviet-era path dependence on the development and effectiveness of innovation systems. This historical context shapes interactions between academia, industry, and government.

The government consistently emerges as the central and often dominant actor in the innovation systems of these nations (Dezhina & Etzkowitz, 2016; Landoni & Muradzada, 2024). This is particularly evident in Russia, where federal funding for research and development (R&D) is overwhelmingly high, leading to a significant dependence on state budgets and comparatively low business investment in R&D (Balzer & Askonas, 2016; Dezhina, 2018). This state-centric approach often manifests as a "Statist" Triple Helix model, where the government's role is prescriptive rather than facilitative, hindering organic cultural development and leading to interaction issues among the Triple Helix actors (Hladchenko & Pinheiro, 2018; Landoni & Muradzada, 2024).

This top-down policy environment frequently results in "innovation by coercion," where institutions are compelled to engage in collaborative activities without genuine underlying demand or capacity (Bychkova, 2016). Universities and companies may resort to strategic mimicry or ceremonial compliance, such as creating fictional spin-offs or "fake" innovations, primarily to report adherence to governmental mandates and secure public funding, rather than fostering effective knowledge transfer or commercialization (Bychkova, 2016; Nurgabdeshov & Moldashev, 2024; Umirzakov et al., 2019b; Yatluk, 2024).

Furthermore, a persistent "science-push" or linear model of innovation, inherited from the Soviet era, continues to influence R&D priorities in many post-Soviet countries, including Armenia and Estonia (Inzelt 2015; Varblane et al., 2008). This model prioritizes fundamental research over applied research and commercialization, creating a significant disconnect between academic output and the practical demands of industry (Thurner & Zaichenko 2018; Yegorov et al., 2022).

Finally, the implementation of innovation policies is often characterized by a lack of consistency, frequent changes, and a top-down approach that fails to account for the actual capacities and operational realities of universities and businesses (Jonbekova et al., 2020; Jumakulov et al., 2018). This can lead to "means-ends decoupling," where policies become disconnected from their intended public welfare goals due to issues such as rent-seeking behaviors and a general lack of understanding of effective collaboration mechanisms (Hladchenko & Pinheiro, 2018; Yegorov et al., 2022).

4.2. Weak Industry Demand and Low Absorptive Capacity

Another critical theme emerging from the literature on UIC in Post-Soviet states is weak industry demand for academic research and a generally low absorptive capacity within firms. This creates a significant barrier to effective knowledge transfer and the commercialization of university-generated innovations.

A fundamental challenge is the scarcity of innovative companies and a limited private sector demand for knowledge or science, severely handicapping industry-science collaboration across the region (Inzelt, 2015; Kenzhaliyev et al., 2021). Companies, particularly in sectors like telecommunications in Kazakhstan, often prioritize short-term production activities or the import of existing technologies over long-term innovation strategies or investing in in-house R&D (Dezhina, 2018; Smirnova, 2015). This preference for readily available solutions over collaborative research diminishes the incentive for firms to engage deeply with academic institutions.

Furthermore, firms in post-Soviet economies frequently exhibit low absorptive capacity, meaning they lack the internal capabilities to effectively identify, assimilate, transform, and exploit

external knowledge from universities (Paliokaitė et al., 2021; Varblane et al., 2008). This is particularly evident in traditional industries and small and medium-sized enterprises [SMEs], where the necessary human capital, organizational structures, and financial resources to engage in complex R&D partnerships are often absent (Roud & Vlasova, 2018; Yegorov et al., 2022).

A significant contributing factor to this disconnect is the prevalent distrust and misconceptions between academia and industry (Landoni & Muradzada, 2024; Smirnova, 2015). Firms often perceive the quality of university research as low or irrelevant to their practical needs, and academics are sometimes seen as unfamiliar with industrial challenges (Jonbekova et al., 2020; Smirnova, 2015). This mutual skepticism and misalignment of expectations can lead to a preference for informal, personal connections between individual researchers and companies, rather than formal institutional collaborations, further undermining the development of robust UIC ecosystems (Khachatryan et al., 2024). Consequently, the benefits of collaboration for companies often remain limited to accessing highly qualified personnel through internships and recruitment, rather than engaging in joint R&D or technology commercialization (Smirnova, 2015).

4.3. Underdeveloped Institutional Frameworks and Infrastructure for Commercialization

A third significant theme in the literature highlights the pervasive challenges stemming from underdeveloped institutional frameworks and inadequate infrastructure for technology commercialization in post-Soviet states. These structural deficiencies often impede effective UIC despite policy efforts.

A recurring finding is the limited effectiveness of Technology Transfer Offices [TTOs] in these regions. In countries like Azerbaijan, Belarus, and Kazakhstan, TTOs are frequently perceived as bureaucratic, lacking expert knowledge, and operating under rules that are not conducive to successful commercialization (Belitski et al., 2018; Kireyeva et al., 2020). This often leads scientists to bypass formal TTO channels, preferring direct interaction with private companies, suggesting that direct industrial funding can be a more efficient conduit for research commercialization than TTOs in these contexts (Belitski et al., 2018). The "Professor Privilege" system, where intellectual property ownership is vested with the inventor, is even proposed as a more attractive alternative to enhance commercialization, as current legislative initiatives may not align with researchers' economic interests (Belitski et al., 2018).

Beyond TTOs, there is a general inadequacy of physical and informational infrastructure. Universities in many post-Soviet states lack specialized technology transfer units, modern equipment, and robust information systems for effective technological exchange (Kenzhaliyev et al., 2021; Novikova et al., 2020). This deficiency is compounded by an aging workforce within scientific organizations, further hindering research and commercialization efforts (Inzelt, 2015). The absence of appropriate regulatory, technical, scientific, and methodological bases for commercialization also contributes to these challenges (Kenzhaliyev et al., 2021).

Furthermore, legislative frameworks regarding Intellectual Property Rights [IPR] and commercialization opportunities for universities and researchers often remain constrained or unclear, disincentivizing innovation (Inzelt, 2015). Even when basic conditions for university-industry linkages are created through legislative changes, they are not always fully supportive, limiting the potential for spin-off creation and other advanced forms of commercialization (Inzelt, 2015). The lack of well-coordinated horizontal and vertical measures in industrial, innovation, and science and technology policies further exacerbates the problem, meaning that measures to stimulate links between academia, business, and government remain underdeveloped (Yegorov et al., 2022).

4.4. Human Capital and Cultural Barriers within Academia

The literature consistently identifies significant human capital and cultural barriers within academia that impede effective UIC in post-Soviet states. These internal dynamics often create a disconnect between policy aspirations for entrepreneurial universities and the lived realities of researchers.

A prevalent issue is the academic focus on basic research over applied work, often driven by the prevailing funding systems. Competitive and excellence-oriented funding mechanisms incentivize academics to prioritize high-level publications in international journals, rather than engaging in applied research or commercialization activities (Kirs et al., 2017). This creates a structural gap where the "entrepreneurial university" rhetoric demands applied research capabilities, but the funding system rewards academic excellence in fundamental science (Kirs et al., 2017). Consequently, scientific activities may become increasingly decoupled from actual technology transfer processes, even within institutions that maintain strong publication records and research performance indicators (Perkmann et al., 2013).

Furthermore, many Russian and other post-Soviet university scholars have a notable lack of entrepreneurial motivation and a general skepticism towards commercialization (Khachatryan et al., 2024; Yatluk, 2024). Academics often perceive establishing spin-offs as a high-risk endeavor, frequently requiring them to resign from their university positions, which is seen as a significant deterrent (Kirs et al., 2017). This leads to a relatively low belief that collaboration will yield increased funding or commercialization of academic output (Khachatryan et al., 2024). The Russian context, in particular, reveals that academic entrepreneurship often manifests as "strategic mimicry" or "ceremonial compliance" to secure resources, rather than genuine market-driven innovation (Yatluk, 2024).

Practical constraints also significantly hinder academic engagement in UIC. Heavy faculty teaching loads and the administrative burden associated with collaborative projects consume valuable time and energy, limiting researchers' capacity for extensive industry partnerships (Jonbekova et al., 2020; Khachatryan et al., 2024). Additionally, while foreign-born scholars are recognized for their role in knowledge transfer globally, their potential for academic entrepreneurship in Eastern Europe remains untapped, mainly due to the structural weaknesses of the innovation systems (Luczaj, 2021). Instead of directly founding spin-offs, these scholars often act as "bridges" to external knowledge and markets, highlighting a different, more informal, mode of knowledge transfer (Luczaj, 2021).

4.5. Emerging Opportunities and Recommendations

Despite the significant challenges and persistent legacies of the past, the literature also identifies several emerging opportunities and offers key recommendations for fostering more effective UIC in post-Soviet states. These insights point towards potential pathways for overcoming existing barriers and building more robust innovation ecosystems. Importantly, these opportunities are not limited to economic and technological dimensions; they also involve substantial transformations within higher education institutions, including teaching practices, curriculum design, and the preparation of students for knowledge-intensive work.

A consistent finding across various studies is the fundamental importance of human capital generated by universities. The teaching mission of universities, particularly in producing educated graduates, is identified as the most crucial predictor of economic development across all stages, from factor-driven to innovation-driven economies (Marozau et al., 2016). This underscores the foundational role of higher education in providing the skilled workforce necessary for economic growth and innovation. UIC can thus be understood not only as a mechanism for knowledge transfer but also as a catalyst for reforming pedagogical approaches (Ajani, 2024; Morris & Glazzard, 2025). By aligning curricula more closely with industry needs, universities can enhance students' employability and foster work-based learning models, which in turn strengthen the feedback loop between education and innovation. Beyond traditional R&D, the education and training of the labor force are considered even more powerful drivers for business–academia collaboration in Central and Eastern Europe (Jonbekova et al., 2025; Paliokaitė et al., 2021).

While government funding currently dominates, there is a recognized need for diversification of funding sources and collaboration channels. Universities are encouraged to seek non-budgetary R&D incomes, as higher publication activity often correlates with a greater share of such funding

(Budyldina, 2018). Collaboration should extend beyond traditional forms like internships and involve more advanced mechanisms, such as joint R&D projects, licensing, and intellectual property commercialization (Kenzhaliyev et al., 2021; Smirnova, 2015). At the same time, embedding these activities within academic programmes can transform them into learning opportunities for students and staff, for example through industry-linked capstone projects, joint supervision of theses, and applied research courses. The effective utilization of modern communication tools, including media and online social platforms, is also seen as a viable and inexpensive way for Ukrainian universities to promote technology and conduct market research in the innovation market (Novikova et al., 2020).

Crucially, successful collaboration is not solely dependent on financial resources but heavily relies on socio-behavioral factors such as motivation, trust, communication, and cultural alignment (Runiewicz-Wardyn & Leśniowska, 2023). This implies that policies focusing solely on financial incentives may be insufficient without addressing these underlying relational dynamics. Strengthening interpersonal trust and organizational learning processes between universities and industry can also have transformative effects on how teaching and research missions are balanced. Governments are advised to create favorable environments for university transformation and inclusion in innovation systems to effectively convert knowledge into economic growth (Marozau et al., 2016). Furthermore, the literature suggests that even in times of crisis, such as wartime in Ukraine, the concept of the entrepreneurial university holds significant potential for recovery and reconstruction, highlighting universities' crucial role as knowledge hubs and innovation drivers even under extreme duress (Starostina et al., 2023). Such resilience further underscores universities' dual function as centers of both knowledge creation and human capital formation, even in adverse conditions.

5. Discussion

The synthesis of our bibliometric maps and thematic analysis reveals three persistent patterns in post-Soviet UIC: (i) continued state dominance coupled with limited firm absorptive capacity; (ii) underdeveloped commercialization infrastructure; and (iii) emergent education-facing opportunities around curriculum reform, work-based learning, and employability. Taken together, these patterns imply that UIC in the region remains structurally skewed toward policy logics and public research supply, while demand-side capabilities and market-oriented transfer mechanisms lag. This configuration both constrains the breadth/depth of collaboration and, counterintuitively, creates room for education-first interventions that are institutionally feasible in the short run.

Positioned within prior literature, our results align with governance-centric accounts of collaboration systems, where the prevailing logic—statist vs. entrepreneurial—conditions network structure and the salience of policy clusters (Radosevic & Yoruk, 2014). The prominence of government and institutional policy themes in our maps is consistent with a field where rules, public funding channels, and formal strategies loom larger than firm-driven problem articulation. In such systems, universities often face multi-principal expectations with limited contracting clarity, and firms underinvest in exploration—features that our co-citation and keyword overlays also suggest.

A capability lens helps explain uneven firm engagement. Consistent with Cohen and Levinthal (1990) and Laursen and Salter (2006), collaboration returns depend on firms' internal R&D effort and openness. Where business expenditure on R&D is low and organizational routines for search, evaluation, and integration are weak, firms capture limited value from academic knowledge, leading to selective participation concentrated in a few tradable sectors. Our country/source profiles and reference structures mirror this dynamic: a small number of capable actors drive visible outputs, while many organizations remain peripheral, reinforcing cumulative advantage and path dependence.

The commercialization interface is likewise thin. The observed weakness of TTOs, incentive frameworks, and IP practices echoes evidence that professionalization, clear role identities, and

aligned incentives are correlated with licensing and spin-off performance (O'Kane et al., 2015). In our thematic map, transfer-infrastructure topics appear as basic or emerging themes rather than dense motor themes, indicating foundational work still in progress. Absent reliable routines for disclosure, evaluation, and deal-making, academics default to informal engagement or education-linked collaboration, which is easier to execute under institutional risk and uncertainty.

Education-facing opportunities constitute the most tractable pathway for near-term impact. Our clusters link directly to curriculum co-design, industry-embedded learning, and employability, consistent with views of UIC as spanning engagement and commercialization (Perkmann et al., 2013) and with syntheses charting a shift from pure tech transfer to broader teaching and student outcomes (Garcia Mendoza et al., 2025; Mascarenhas et al., 2018; Rothaermel et al., 2007). Concretely, universities can implement co-taught modules, capstone projects with industry briefs, joint supervision, and short cycle applied-research courses that build boundary-spanning skills, while standardizing lightweight IP/contracting playbooks to lower transaction costs for faculty and partners.

Theoretically, our evidence supports capability- and governance-based explanations but also points to role-conflict dynamics within universities—tensions among teaching, research, and third-mission work—as a missing mechanism. Future models should integrate micro-level motivational constructs (perceived utility, risk, identity work of academics) with meso-level interface maturity (TTO age, staffing, IP clarity) to explain variance in engagement modes beyond funding levels alone. This multilevel specification would better capture how individual incentives interact with organizational routines and macro-governance constraints.

Finally, to explain cross-national heterogeneity, comparative modelling should incorporate a compact panel of measurable moderators: GDP per capita and R&D intensity; university autonomy; governance quality; TTO presence and age; doctoral production per 100k; and sectoral composition (tradables share). These moderators can be linked to observable outputs (joint publications, industry-funded projects, licenses, spin-offs) and education-facing outcomes (capstones, internship conversions, graduate employability). In sum, the region's UIC trajectory will depend on simultaneous progress in firm capabilities and commercialization routines, but higher education interventions offer a credible near-term lever to build trust, reduce frictions, and seed demand for deeper collaboration.

6. Future Research Directions

Building on the gaps identified in this bibliometric–thematic review and aligning them with calls emerging from wider UIC reviews, we outline seven interrelated avenues for future scholarship. These future research directions should not only address innovation policy and collaboration dynamics but also explicitly explore their pedagogical and educational implications.

Most studies remain cross-sectional and country-specific. Longitudinal mixed-method designs that track the same universities, firms, and policy initiatives over time would illuminate how institutional reforms, crises (e.g., wartime disruptions), and learning effects shape collaboration trajectories. Such work answers repeated calls for dynamic, process-oriented research in the global UIC literature (Ankrah & Al-Tabbaa, 2015; Perkmann et al., 2013). These designs could also capture how sustained industry engagement reshapes teaching missions, academic careers, and student experiences within universities over time (Bogas, 2023).

While weak industry demand and low absorptive capacity are well documented, we still know little about the individual-level mechanisms—trust formation, motivation, boundary-spanning roles—that convert contacts into productive projects. Recent review work highlights the need to integrate psychological and behavioral constructs into UIC models (Baleeiro Passos et al., 2023). Fine-grained qualitative studies, conjoint experiments, and social-network approaches could address this gap. Furthermore, there is scope to examine how these micro-level processes intersect with educational practices, such as project-based learning, co-supervised student work, and pedagogical innovation in applied fields.

The COVID-19 era accelerated virtual laboratories, cloud R&D, and platform-based innovation contests (Azennoud, 2022; Ceballos et al., 2021). Yet digital modes of UIC remain understudied in post-Soviet contexts. Future work could examine how digital infrastructures mitigate geographical–institutional barriers, alter the governance of intellectual property, and reshape the costs of partnering. Integrating insights from the open-innovation and platform literature would extend traditional Triple/Quadruple Helix models. Such research could also explore how digital collaboration affects educational delivery, including hybrid industry–university teaching models, online internships, and virtual mentoring schemes that integrate students into real innovation processes.

7. Conclusion

This bibliometric investigation offers a methodical examination of research related to UIC in post-Soviet nations, emphasizing the intellectual framework, principal thematic areas, and emerging patterns within the domain. By utilizing co-citation and bibliographic coupling methods, this analysis pinpoints key research clusters that have influenced discussions on UIC, especially in transitional economies. The results reveal that although UIC has attracted scholarly interest in post-Soviet countries over the last thirty years, the area is still less explored than in Western contexts. The progression of research themes illustrates an increasing focus on institutional structures, industry engagement strategies, and knowledge transfer mechanisms, highlighting the intricate nature of UIC dynamics in this area. In addition, this study highlights how these collaborations intersect with higher education systems, influencing academic missions, teaching practices, and student learning opportunities.

A significant contribution of this research is its depiction of UIC research pathways, showing how collaborative models have evolved in response to economic and policy changes in post-Soviet nations. The rising number of publications since 2013 indicates a developing research area, marked by enhanced interdisciplinary collaboration and methodological variety. The investigation also emphasizes the importance of policy measures in determining UIC efficacy, with findings indicating that a more tailored approach to policy formulation is crucial for nurturing sustainable university–industry collaborations. Such tailored approaches should consider not only innovation performance but also the educational functions of universities as key actors in human capital formation.

Nonetheless, despite these progressions, various obstacles remain. Institutional limitations, unclear regulations, and inadequate funding opportunities still impede the realization of UICs in post-Soviet countries. Furthermore, the uneven spread of research outputs across various nations highlights the necessity for improved regional cooperation and knowledge-sharing efforts. Tackling these issues demands a more cohesive strategy that unites policymakers, industry executives, and academic institutions to establish strategic frameworks that boost the success of UIC. From an educational perspective, such frameworks should also integrate mechanisms to support curriculum reform, faculty development, and student-industry engagement as central pillars of collaboration.

This research enhances existing literature by providing a thorough overview of UIC studies in post-Soviet nations and suggesting a pathway for future exploration. To propel the discipline forward, subsequent research should concentrate on emerging topics such as digital collaboration, the influence of artificial intelligence on knowledge transfer, and the effects of international partnerships on UIC performance. Additionally, advancements in methodology, including longitudinal studies and mixed-methods approaches, are essential for better understanding UIC's long-term effects. Crucially, these efforts should connect innovation-oriented collaboration with broader educational change, recognizing universities as both knowledge producers and pedagogical institutions.

8. Limitations

This study, while extensive, is not without limitations. Firstly, the reliance on bibliometric data from primarily English-language publications and major databases such as the Web of Science may omit significant contributions published in other languages or contained within regional databases. Future research works may broaden the dataset to include additional databases such as Scopus and relevant regional repositories (e.g., eLIBRARY, CyberLeninka) with careful de-duplication procedures, so as to capture a wider and more representative picture of university–industry collaboration across post-Soviet countries. These limitations could potentially skew the understanding of the UIC landscape as it pertains to non-English-speaking regions or less-documented academic contributions. Secondly, the study's retrospective nature and the inevitable delay in publication indexing mean that the most recent developments in UIC may not be fully reflected in the data analyzed. The fast-paced changes in global economic conditions and technological advancements necessitate ongoing updates to this research to maintain its relevance and accuracy. Lastly, while the study identifies significant trends and patterns in UIC research, it does not deeply delve into the effectiveness or outcomes of these collaborations in practical terms. Future studies may incorporate social and contextual moderators—such as socio-economic conditions (e.g., GDP per capita, R&D intensity, business expenditure on R&D and institutional characteristics (e.g., university autonomy, governance quality, presence and maturity of TTOs—to explain national and regional differences in UIC patterns. Also, future research could benefit from incorporating case studies or empirical research that assesses the impact of UIC on technological innovation and economic growth in post-Soviet states. Moreover, integrating pedagogical outcomes—such as graduate employability, curriculum modernization, and student engagement with industry—would enrich the understanding of UIC's broader societal role. Together, these extensions will help mitigate language and coverage biases and yield a more comprehensive evidence base for both policy and educational practice.

Author contributions: All authors contributed to all the processes of the manuscript, including conceptualization, data collection, analysis of the data, and reporting.

Data availability: The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Declaration of AI-assisted technologies in the writing process: The authors used AI tools for grammar correction, language refinement, and stylistic adjustments to enhance the clarity and coherence of the manuscript.

Declaration of interest: The authors disclose that they have no actual or perceived conflicts of interest.

Ethical statement: Because no human studies are included, this study does not require ethical approval.

Funding information: This research was supported by the Ministry of Science and Higher Education of Kazakhstan under the project BR21882077, titled "Improving Mechanisms for the Effective Regulation of Commercialization Processes for Applied R&D Projects".

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